Form ESA-B4. Summary Report for ESA-250-3
Public Report - Final

Company	United States Steel Corporation	**ESA Dates**	December 1st – 3rd 2008
Plant	Fairfield Works	**ESA Type**	Fan Systems
Product	Steel	**ESA Specialist**	Pierpaolo Baldisserotto

Brief Narrative Summary Report for the Energy Savings Assessment:

Introduction: U.S. Steel's Fairfield Works near Birmingham, Alabama is a steel manufacturing facility. Fans are primarily used at the facility to ventilate enclosed spaces and to remove exhaust gasses from certain areas.

Objective of ESA: The objective of this ESA was to introduce the facility to FSAT and to find and evaluate new opportunities for energy savings using FSAT.

Focus of Assessment: The focus of the assessment was to train the facility personnel on how to select fan systems to analyze, how to take measurements on the selected fan systems, and how to use the FSAT software tool to evaluate the fan system efficiencies. The fan systems that were analyzed during the assessment include the following:

1 – 1,500 hp – QBOP bag house fan
2 – 100 hp – Sheet Mill ventilation fans
1 – 100 hp – Pickling Line exhaust fan
1 – 100 hp – Cold Mill exhaust fan
1 – 75 hp – Sheet Mill ventilation fan
6 – 50 hp – Cold Mill air washer fans
2 – 40 hp – Cold Mill MG booster fans

Approach for ESA: An introduction meeting occurred at the beginning of the assessment. The meeting covered topics including methods to determine which fan systems should be chosen to optimize, how fan curves and system curves interact, and the effects system components have on overall fan system efficiencies. During the meeting several fans in the facility were selected to analyze. Data was then collected on the selected fan systems. The facility personnel were trained in using FSAT and the data that was collected on the fan systems was analyzed. Finally, a close out meeting was performed covering the results from the findings.

General Observations of Potential Opportunities:

- Total plant electrical usage for base year 2007, 485,000 MWh (1.655 TBtu).
- Near Term Opportunities :
    - Reduce the flow rate from the ventilation fans used in the Sheet Mill building when the outdoor temperature is low enough. Two 100 hp fans and one 75 hp fan are used in the Sheet Metal building to ventilate the basement. This is done to keep the basement from overheating and to reduce the amount of gasses that build up in the basement. Currently these fans operate at full load 8,760 hours per year regardless of the outdoor temperature. During the site visit, it was noted that the temperature in the basement was well below the maximum temperature for the basement.

      It is recommended to install a temperature sensor in the basement and control the fan speed based on the temperature in the basement. It is assumed that the fan speed can be reduced to 80% of the full fan speed when the outdoor temperature is below 60°F, the fan speed can be reduced to 70% of the full fan speed when the outdoor temperature is below 50°F, and the fan speed can be reduced to 60% of the full fan speed when the outdoor temperature is below 40°F. Furthermore, it is assumed that the minimum ventilation required for the basement to remove the gasses is 60% of the full fan speed. These assumptions should be verified by the facility.

      This recommendation could save the facility 500,000 kWh per year for an annual cost savings of $27,600. Since these motors are DC motors, a simple controller can be used to control the speeds of the fans. Due to the low investment cost, this recommendation is considered to be a Near Term Opportunity.

- Reduce the flow rate from the Service Combustion 100 hp ventilation fan so that it matches the flow rate from the Lee Wilson 100 hp ventilation fan. Each of these fans provides ventilation to a basement of equal size. However, the flow rate from the Service Combustion fan is approximately 35% higher that the flow rate from the Lee Wilson fan. It is recommended to reduce the speed of the Service Combustion fan such that the flow rates from the two fans are the same.

  It is believed that the exhaust damper on the Lee Wilson fan is partially closed leading to a lower flow rate than that from the Service Combustion fan. Therefore it is also recommended to ensure the exhaust damper is fully open. By opening the damper, the flow rate from the fan as well as the power consumption of the fan will increase. Since this additional flow rate is unnecessary, it is recommended to slow the fan down such that the flow rate from the fan at a slower speed matches the flow rate from the fan when the damper was partially closed. The cumulative savings for slowing these fans down and opening the exhaust damper could save the facility 1,050,000 kWh per year or $58,200 per year.

  The fans in this recommendation are the same fans from the first recommendation. If this recommendation is implemented, the savings from the first recommendation will be reduced.

- Repair the exhaust dampers on the 6 – 50 hp air washer fans in the Cold Mill. Originally the damper on each fan was designed to close automatically when the fan was off and the other fans were running. However, over time the dampers have become stuck allowing a portion of the air from the fans that are running to recirculate through the fans that are off. Without performing additional tests, the savings from repairing or replacing the dampers cannot be obtained. However, due to the low cost of the dampers, it is recommended to repair or replace the dampers immediately.

- Seal the gaps between the doors and the floor in the MG fan exhaust rooms. Four 40 hp MG booster fans blow cooling air to rooms that in turn provide cooling to the motor generator sets in the Cold Mill. During the assessment, it was noted that a noticeable amount of air is escaping from the pressurized rooms into the basement. It is recommended to seal the space between the doors to the rooms and the floor to reduce the amount of “leaked” air.

- Medium Term Opportunities :
  - Investigate the reason behind the low fan efficiencies of the 4, 40 hp MG booster fans in the Cold Mill. The static pressures across the fans and the flow rates were measure on two of the four 40 hp MG booster fans in the Cold Mill. Using FSAT, it was determined that the fan efficiencies for these systems were around 40%. An optimally sized fan at the required flow rate and static pressure can achieve fan efficiencies of 83%.

    It is recommended to investigate the fan systems to determine the reason behind the low fan efficiencies. There did not appear to be dampers between the fans and the points at which the measurements were taken. Therefore, exhaust dampers can not be accountable for the loss of energy in the fan systems. However there may be other obstructions in the ducts that are causing reduction in static pressures and in fan efficiencies. If it is determined that there are no obstructions in the systems causing the low fan efficiencies, the fans should be replaced with new optimally sized fans. Due to the relative cleanliness of the air streams, airfoil fans should be used in the application if it is determined that the fans need to be replaced. The facility could save 513,000 kWh per year and $30,000 per year if the fan efficiencies can be increased to the optimal efficiencies.

- Long Term Opportunities :
  - Install a variable speed drive on the QBOP Bag House fan. The fan is used to remove exhaust fumes from the QBOP furnace. Two intake ducts over the furnace merge into one duct before the fan. The exhaust from the fan discharges the fumes to a baghouse. Occasionally higher velocity is needed in one of the ducts, so a damper in the second duct is closed off. However, the majority of the time both dampers are open.

    It appears as if the full flow rate from the fan is not needed when both of the intake dampers are open. Therefore, it is recommended to install a VFD on the fan and reduce the speed of the fan to the minimum required flow rate when both of the intake dampers are open. It is assumed that the flow rate from the fan can be reduced to 75% of the full fan speed when both dampers are open. It is also assumed that both dampers are open 4,380 hours per year. These assumptions will need to be verified by the facility. The facility could save 2,220,000 kWh per year for an annual cost savings of $122,000 if they were to implement this recommendation.

- Repair or replace the air washer fans in the Cold Mill. The 6 - 50 hp air washer fans appear to be in poor shape. Holes are developing in many of the fan housings and the impellers appear to be rusting. We were unable to take field measurement to determine the fan system efficiencies due to the configuration of the fans. The fans discharged directly into a chamber in a basement preventing us from taking flow measurements.

  It is recommended to perform additional tests to determine the efficiencies of the fan systems. Temporary ducts could be placed at the discharge of the fans so that one could take flow readings for each fan. If the fans are found to have low efficiencies, they should be replaced with new, optimally sized fans.

Management Support and Comments:

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